Zn-based Batteries

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Long Duration Energy Storage Workshop: Battery Storage

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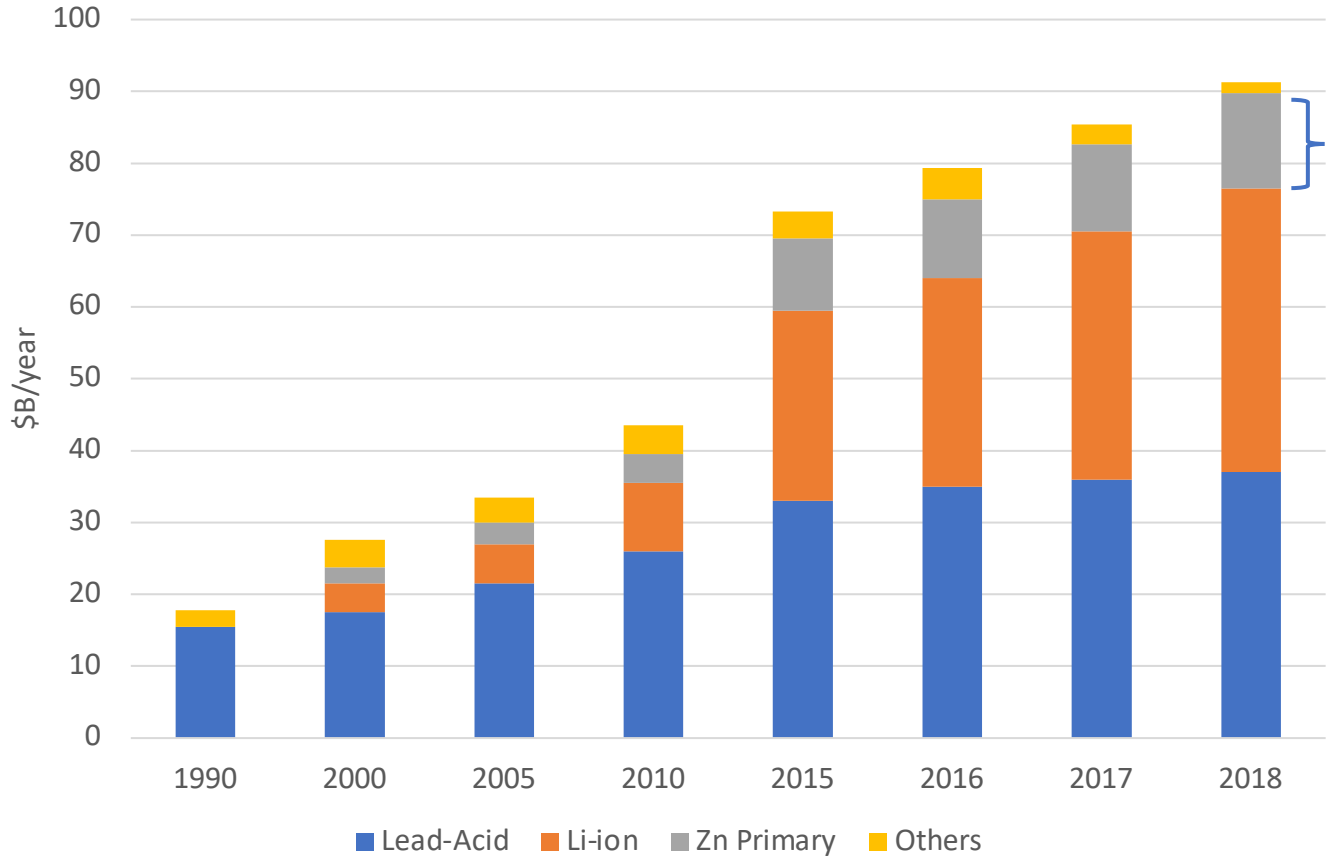
Long Duration Energy Storage Workshop: Battery Storage Panel
Zn-based Batteries

Zinc already provides long-duration storage in the form of primary cells: sales of $13B/year

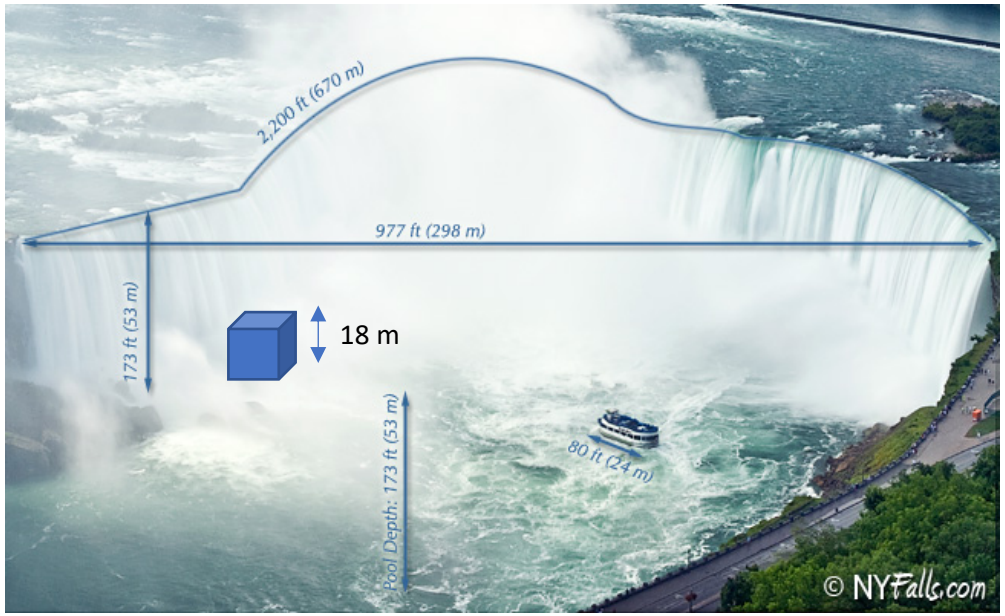


Where are we today?

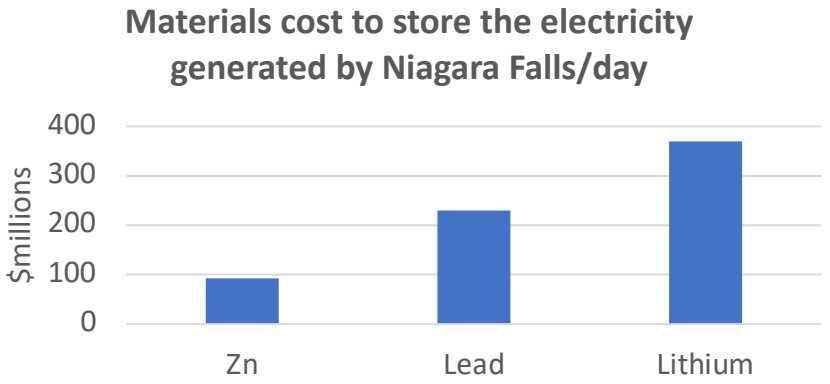
- Zn Primary cell sales ~ $13B/yr growing
- Li-ion sales ~$40B/yr growing
- Lead-Acid sales~$38B/yr stable
- Other battery sales (NiCd, NiMH, Flow batteries, NAS, …) ~$1.5B/yr decreasing

Why Zn for Electrochemical Energy Storage? (theoretical capacity assumed for metal-air cells)

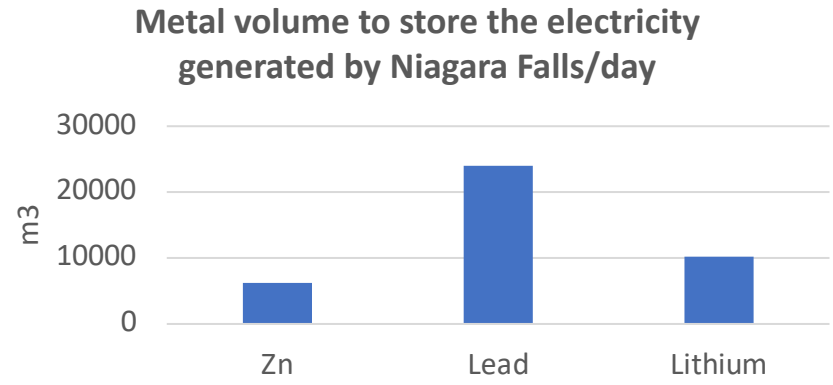
Electricity generated by Niagara Falls: 60,000 MWh/day



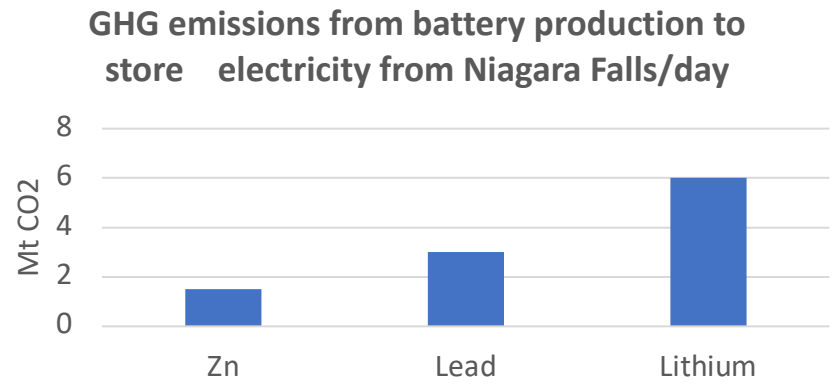
Inexpensive



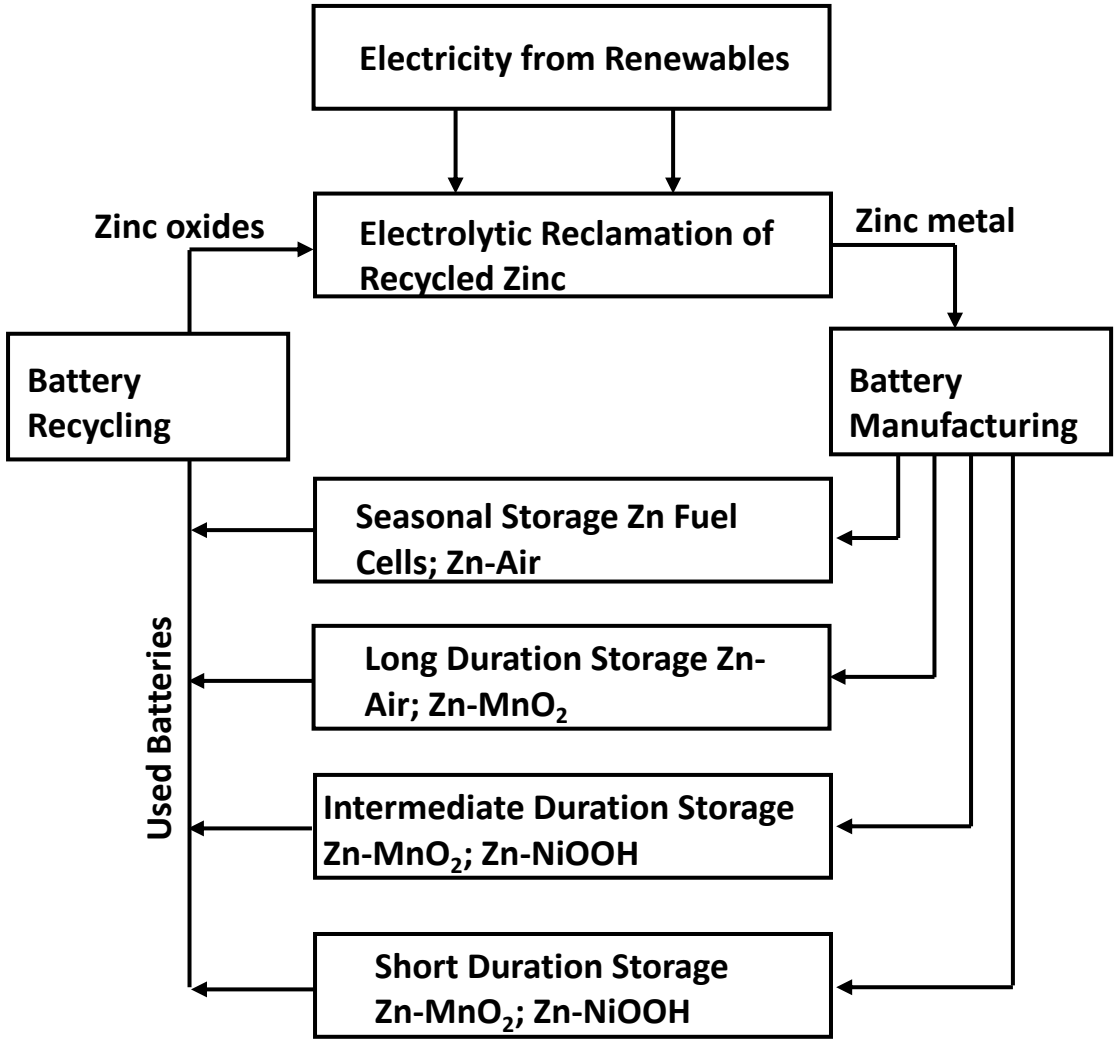
Energy dense



Low GHG Emissions



The Zinc Cycle: Can Serve Multiple Duration Time Scales



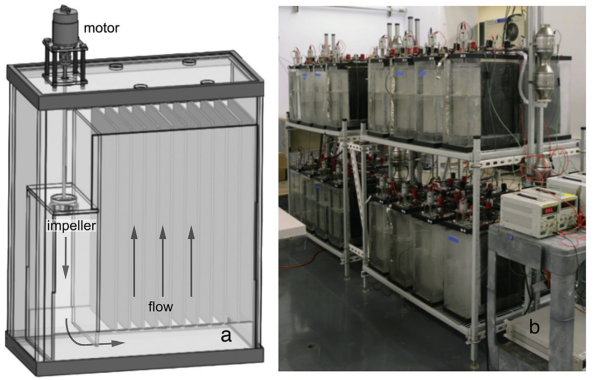
	Time Scales	Battery	RTE	Cycles
Seasonal	Years → Months	Zn-Air	70%	Tens
Long duration	Months → Days	Zn-Air, Zn-MnO_2	70%, 76%	Hundreds
Intermediate duration	Days → Hours	Zn-MnO_2, Zn-Ni	76%, 96%	Thousands
Short duration	Hours → Minutes	Zn-MnO_2, Zn-Ni	76%, 96%	Tens of thousands

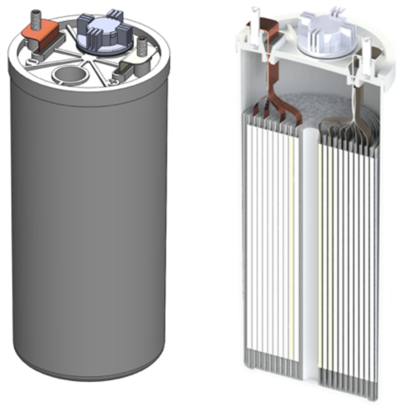
Zinc Cycle Components

Zinc Reclamation Plant

Zn-Air Battery:
Seasonal and long duration storage

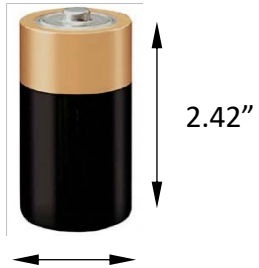
Zn-Ni Battery:
Intermediate and short duration storage



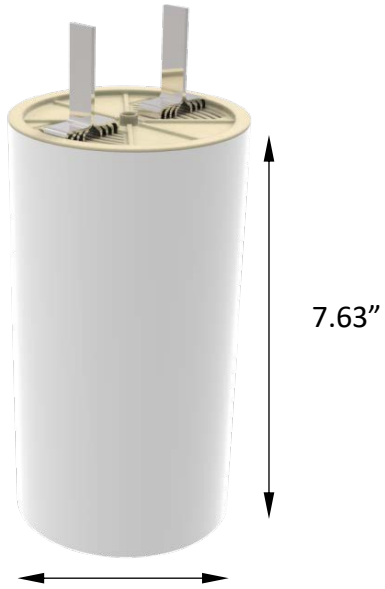


Zn-MnO_2 Battery:
From long duration to short duration storage

UEP Cell for Long Duration Energy Storage



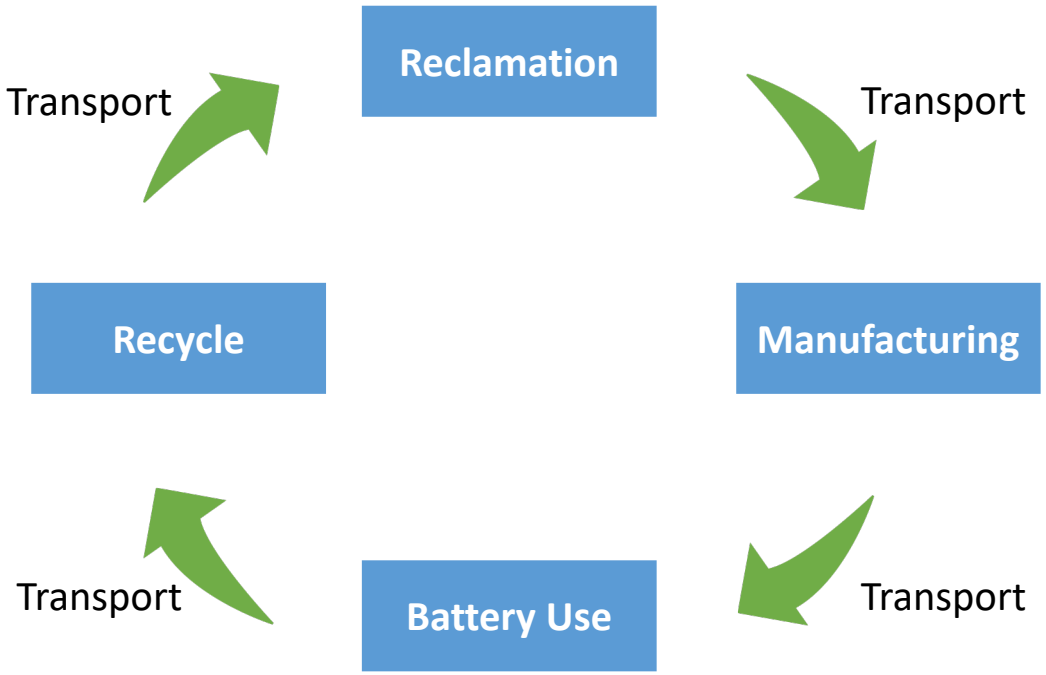
Alkaline Primary D Cell



UEP Gen 1 Rechargeable Cell

	D Cell	UEP Gen 1 Cell
Capacity (140-hour discharge) / Ah	14	350
Volume / mL	56	1600
Weight / kg	0.14	3.6
Average discharge voltage / V	1.25	1.3

Zinc Cycle Development Challenges



Reclamation:

- Improving RTE of Zinc reclamation process from lower RTE acid process to higher RTE alkaline process

Manufacturing:

- Designing batteries to facilitate recycle of anode and cathode materials.

Battery technology:

- Developing low-cost, high cycle life air cathodes.
- Developing long-life ion selective separators for zinc batteries
- Improving cycle life of high DOD zinc anodes
- Developing high voltage aqueous zinc batteries: dual electrolyte, and/or water-in-salt electrolytes(WISE)

Recycle:

- Improving material separation and reducing energy use.